FINDINGS OF COMPLIANCE

DREDGED MATERIAL DISPOSAL OPERATIONS

SKIPANON FEDERAL NAVIGATION PROJECT

APRIL 1981

1. Synopsis. Sediment samples were obtained for elutriate, bulk sediment chemical, benthic, and physical analyses from the Skipanon navigation channel at river miles (RM) .5, 1.0, 1.5, and 2.0 on 22 July 1980, and from inwater sites which have been or will be used for disposal of sediments dredged from the navigation channel. Water from the Columbia River estuary and from the ocean was collected and chemically analyzed for use in performing tests and comparison with the elutriate data.

BACKGROUND

2. The Skipanon navigation channel is located on Skipanon River, Oregon. The mouth of this river empties into the west side of Youngs Bay, on the south side of the Columbia River estuary and opposite approximately Columbia RM 10.7 (figure 1).

3. Cullaby Lake is the source of Skipanon River. This lake is a 2-mile long, 1/4-mile wide body of water which is located in the northwestern part of Clatsop County, Oregon. From the lake, the river flows in a generally northerly direction for about 8 miles to the Columbia River.

4. The Skipanon River drainage basin is 15 square miles. The small size of the drainage area and the retarding effect of Cullaby Lake result in a small runoff, and the tidal influence in the river is great. The tidal range between mean lower low water and mean higher high water is about 8 feet at Warrenton with an extreme tidal range of 12 feet. The head of the tidewater is at approximately RM 4.5. Levees have been constructed along the lower portion of the river to protect the adjacent lands and the city of Warrenton from

tidal overflow. Boat moorages and repair facilities, fish processing plants, municipal wastes, a large sawmill, and log rafting all contribute to water and sediment quality degradation in the vicinity of Warrenton. The upstream portions of the drainage basin have been extensively lumbered in the past and are now managed for forestry products and used for farming and dairying.

5. The navigation project in Skipanon River consists of a channel 30 feet deep and 200 feet wide, which extends from the Columbia River navigation channel to RM 2.0. This portion of the channel includes a 30-foot-deep turning basin and 12-foot-deep mooring basin at Warrenton. In addition, a channel 6 feet deep and 40 feet wide with increased widths at log dumps and terminals, extends for a distance of 4,500 feet above RM 2.0.

6. The U.S. Army Corps of Engineers maintains the authorized depths of the mooring basin and navigation channel. From 17,000 to 19,000 cubic yards of shoaled sediments are removed from the project annually with the exception of occasional years when no dredging is performed. Shoaled sediments are removed with an agitation, pipeline, or hopper dredge.

7. Materials from pipeline dredges have been discharged upland in the past. Hopper dredges have discharged materials at the Tansy Point and Area D disposal sites and may discharge at ocean disposal sites in the future (figure 1). The agitation dredge has been used only to remove sediments which shoal at the mouth of the navigation channel.

8. The sediments which have been dredged in the Skipanon navigation channel in the past have been classified as silty sands. Portland District, Corps' guidelines specify that dredged sediments must undergo chemical analysis to determine pollution potential if the sediments consist of more than 20 percent by weight of particle sizes smaller than sand.[2] If silty sediments are to be discharged at an open-water site, the sediments and water at the disposal site must also undergo chemical analysis to assess the impact of the discharge. Pursuant to these guidelines, samples for physical and chemical analysis were collected in 1980 from the Skipanon navigation channel, Area D, and the Tansy Point disposal site. Proposed future ocean disposal sites were not sampled since the authority (Section 404 of Public Law 92-500)[1] under which the other

sampling was done covered fresh and estuarine areas only. However, water from the ocean disposal site E (located near the end of the Columbia River north jetty) was collected for chemical analysis and for use as eluate in the elutriate tests. This testing was done to provide information on comparable impacts of disposing at the various sites and to avoid the need for additional, time-consuming sampling should data be required on the ocean disposal activities. The parameters which were chemically analyzed were those with which the sediments may have been contaminated given the point and nonpoint contaminant sources for the area (table 7).

9. Water quality in the Columbia River and its estuary are generally good. Temperature and radioactivity are the two parameters of most concern in the overall water quality although degradation to some sections of the waterway from specific point or nonpoint sources occur. Temperature usually exceeds the desirable levels for salmonids in August, but is satisfactory for the remainder of the year. Radioactivity is high primarily as a result of discharges by the Hanford Atomic Works upstream of Richland, Washington, and the Trojan Nuclear Power Plant near Rainier, Oregon.[3] In addition to the above parameters, supersaturated levels of dissolved gases have been produced by spilling of dams. This factor can be critical to salmonids by causing the gas bubble disease in them.

10. The U.S. Geological Survey (USGS) reports that a "turbidity maximum" normally develops in the Columbia River estuary because of a net circulation pattern in which dense saline water flows landward in the bottom layers and less dense freshwater flows seaward in the surface layers. The turbidity maximum is an area within which concentrations of suspended sediment, including some sand, are substantially higher than they are either downstream toward the mouth of the estuary or upstream in the Columbia River.

11. The Columbia River is the largest river in Northwest United States in both flow and drainage area, and is second in size only to the Mississippi River in the United States as a whole. The Columbia River drains an area of 258,000 square miles. The flow at its mouth is highly regulated by dams and ranges from 150,000 to 600,000 cfs. The high flow permits a good flushing

action in the upper reaches of the river, but it is significantly slowed in the estuary both by the tidal action and larger channel capacity.

12. The tidal effect during low riverflow varies from 7 to 8 feet at the mouth of the Columbia River to 1 to 2 feet at Bonneville Dam (RM 207). Riverflow reversal from the tide has been observed as far upstream as Prescott (RM 72). Ocean water intrusion may extend as far as RM 20. Salinity in Youngs Bay has been shown to range from .6 to 10.1 parts per thousand (ppt) over a single day's tidal cycle.[10] The stilling effects of tidal action significantly increase the amount of sediment deposited and retained at the mouth and in the estuary of the Columbia River. Sources of the sediment include both the ocean and the Columbia River and its tributaries.

13. Sources of sediments which are worthy of particular mention are the mudslides and ash fallouts which resulted from the 18 May 1980 eruption of Mount St. Helens. This eruption placed millions of cubic yards of sediments and wood debris into the Columbia River system and released ash which settled in most parts of the watershed. Erosion and further eruptions are expected to continue to place sediments, wood debris, and ash into the waterway.

14. To date, chemical analyses of both ash and sediments which were washed into the Cowlitz and Columbia Rivers have shown that the materials did not contain significant amounts of any contaminants of concern.[4] Of perhaps greater concern than the content of the sediments is the large amount of small grain-sized sediments and ash which have entered the watershed and washed down to the estuary. These materials suspend readily and could result in higher turbidity levels than have occurred in the past during dredging and disposal activities. Settling of these materials in the estuary may have a serious impact on the ecological balance of the benthos in the area, and could impact the proposed dredged material disposal sites. Impacts to sediment quality in Skipanon channel are expected to be minimal.

15. There are no known municipal and private water supply intakes, wildlife sanctuaries and refuges, wetlands, mudflats, vegetated shallows, parks, national and historic monuments, national seashores, wilderness areas, or research sites in the vicinity of any of the proposed disposal sites. The

Columbia River estuary and the ocean near its mouth are well-known recreational and commercial fisheries areas, but these human use characteristics are not expected to be significantly impacted by the proposed operations.

SAMPLING LOCATIONS AND TEST METHODS

16. The sediment samples which were collected for physical and chemical analyses were obtained from the Corps' 22-foot trihull, FORT STEVENS. This boat was also used to obtain water samples from the Columbia River estuary and benthos samples. A 60-foot charter boat was used to collect water from the ocean.

17. Sediment samples collected for chemical analyses underwent elutriate and bulk sediment analyses. Water samples from the proposed disposal sites were used in performing the elutriate tests and were analyzed to provide background data on the water quality at the dredged material disposal sites.

18. When possible, sediments which were sampled for chemical analysis were obtained with a 220-pound, 9-foot-long gravity corer which was equipped to obtain 2-foot cores in detachable, 2-5/8 inch diameter, acid-cleaned core liners. The core liners were made of transparent cellulose butyrate acetate and were sealed with polyethylene caps.

19. An acid-cleaned, stainless-steel core catcher was attached to the mouth of each core liner to facilitate retention of the sediment sample during retrieval of the corer. The core catchers were removed before storing the samples in ice for transport to the analytical laboratory. This sampling method provided relatively undisturbed and well-preserved sediment samples. Upon reaching the laboratory, the samples were extruded, composited, and subsampled for elutriate, bulk chemical, and/or physical analysis.

20. A 9 by 9-inch, 45-pound Ponar Grab sampler was used to obtain benthic samples. It was also used to sample for physical analyses at those stations where insufficient sediment was obtained in the core samples to allow subsampling them for physical analyses. The benthic samples were sieved through

30 mesh wire. The retained fraction was then preserved with formaldehyde and stored for future analysis. The benthic data are not presented here. The water samples were obtained with an 8-liter, Van Dorn water sampler.

21. A Hydrolab 8000 water quality testing system was used to measure dissolved oxygen (DO), pH, oxidation reduction potential (ORP), conductivity, and temperature at various sites in Skipanon, Columbia River, and the ocean (table 4).

ANALYTICAL METHODS

22. The majority of the elutriate and all of the bulk sediment analyses were performed by USGS following the procedures discussed in the USGS publication, "Native Water, Bottom Material, and Elutriate Analyses of Selected Estuaries and Rivers in Western Oregon".[11] The exceptions to this were cyanide, phenolics, orthophosphate, and phosphate elutriate analyses. These were performed by the Corps' North Pacific Division Materials Laboratory on eluate provided by USGS. Methods were those described in the 14th Edition of Standard Methods for Examination of Water and Wastewater.[2] All chemical methods used have been coordinated with and approved by the Environmental Protection Agency. The physical analyses were also performed by the Division Materials Laboratory.

SAMPLING LOCATIONS

23. On 22 July 1980, sediments for elutriate, physical, bulk chemical, and/or benthic analyses were collected from the Skipanon navigation channel at RM .5, 1.0, 1.5, and 2.0. Additionally, 7 samples from RM 1.19 to 1.95 were taken for physical analyses on 31 January 1980. On 10 and 19 August 1980, sediment samples were obtained from upstream, downstream, and within the Tansy Point disposal site (figure 1). On 19 and 20 August 1980, samples were obtained from upstream, downstream and within Area D opposite approximately RM's 7.0, 6.0, and 6.6, respectively (table 2).

24. Elutriate analyses were performed on all sediment samples except those from Area D using water collected from 2 meters of depth at Tansy Point at 1500 hours on 25 July 1980, or from the ocean at 0901 hours on 24 July. The latter sampling site was located one-half mile seaward of the end of the Columbia River south jetty. Water for the Area D elutriate tests came from Columbia RM 6.6 (in middle of Area D). A sample of water from Area D was obtained on 19 August 1980 and analyzed to determine ambient water quality in the area. Elutriate testing with salt or fresh water provides data representative of the extremes in salt content present within the disposal sites given varying tides and riverflows. The ocean water elutriates also provide information on impacts from ocean disposal operations.

25. In addition to being used for elutriate analysis the water samples underwent standard water quality analyses.

EVALUATION PROCEDURE

26. Elutriate data on the navigation channel sediments are compared to Corps guidelines and to the analytical data on the water samples to estimate the water quality impacts of discharging dredged materials. The majority of the guidelines were promulgated in the Environmental Protection Agency (EPA) publication, Quality Criteria for Water,[5] and updated in the 28 November 1980 Federal Register,[6] and provide for the protection and propagation of fish and other aquatic life and for recreation in and on the water in accord with the 1983 goals of Public Law (PL) 92-500. The criteria were established primarily as a tool for evaluating long-term discharges from industrial point sources, not for assessing intermittent releases from dredged material discharge operations or long-term releases from discharged sediments. However, they provide a protective set of guidelines for use in assessing the discharge impacts. Parameters without specific EPA criterion were assigned guideline values based on available literature and/or State standards.

27. If a parameter was present at greater levels in the elutriate analyses than in the guidelines and receiving water, dredged material disposal may negatively impact water quality at the disposal site. The mixing zone and

environmental characteristics at the disposal site must be taken into consideration to determine the magnitude of the impact.

28. The elutriate and bulk sediment chemical data on the disposal site sediments are compared to that on the navigation channel sediments to determine if there are significant differences in the levels of potential contaminants. Those parameters which are readily bioaccumulated, such as certain toxic organic substances, mercury, and lead, are of particular concern during the bulk sediment analyses. The bulk sediment chemical data on any station can also be used to aid in interpretation of the elutriate data since certain parameters may be released at high or low levels during an elutriate test even though they are not present in a sediment at such levels. When interpreting the bulk sediment data, it must be remembered that they are representative of the total amounts of the parameters present in the sediment including those bound mineralogically. They are not necessarily a measurement of the amounts which are readily available for chemical reaction and biological uptake. The elutriate and background data help in predicting these latter potentials.

29. Sediment physical analyses were performed to determine if the sediments met the exclusion criteria set up in Section 227.13(b) of the ocean dumping regulations[13] and Section 230.4-1(b)(1) of the Section 404 regulations.[1] The criteria specify that dredged materials which are composed predominantly of particles of sedimentary material with grain sizes larger than silt do not have to undergo an evaluation of chemical-biological interactive effects. The Portland District, Corps of Engineers, conservatively defines such sediments as those in which at least 80 percent by weight of the particles are larger than silt and in which less than 6 percent organics or volatile solids are present.

30. The grain size of sediments is of importance in determining both physical and chemical impacts of discharge operations. Fine grained materials, in comparison to larger grained, tend to adsorb more contaminants; suspend more readily, thus influencing turbidity levels; form fluid mud layers, thus providing unstable benthic habitats; and spread further upon discharge, thus increasing the size of the area initially impacted. Also, deposits of

sediments of grain sizes different from those at the receiving site can result in a greatly altered benthic population which may or may not be more productive than the former.

RESULTS AND DISCUSSION

31. Physical Data. Sediments from the navigation channel ranged from sandy silt to silt and contained increasing levels of volatile solids the further upstream the samples were obtained (figure 2 and table 3). The sediments at Tansy Point also ranged from sandy silt to silt, but this sediment contained comparatively little volatile solids. The sediments at the two sites were comparable in roundness grade and density. Void ratios in both areas were high but the navigation channel sediments were up to three times that of the disposal sites. A typical maximum void ratio for uniform, subangular sand is .85.[7] The disposal site sediment ranged from .78 to 3.16 and the navigation channel from 7.15 to 13.79.

32. The disposal site sediments in the downstream area of Tansy Point contained clumps of clay, such as form subsequent to dredged material discharging, as well as surface deposits of pumice and volcanic rock which are believed to have originated from the 1980 Mount St. Helens mudflows. Sediments from the upper portion of the navigation channel appeared of a different consistency than the Tansy Point disposal site sediments, probably as a result of the former's high organic content (table 3). This organic material is most likely responsible for the sediments high void ratio. Since materials with high void ratios are inherently unstable, the discharge of the sediments at an inwater disposal site could result in a fluid mudflow which would tend to spread further than would otherwise be expected given the sediments grain size and density characteristics. The material would also be expected to move out of the disposal sites at a quick rate under the influence of tide and riverflows. Sediments from RM 0 to 1 in the navigation channel were sandier in texture and should not form fluid mud layers upon discharge.

33. All sediment samples from Area D were sand and contained volatile solids levels below District guidelines. Sampling for benthic analyses downstream

from Area D revealed clumps of fine-grained matter such as are formed subsequent to dredged material discharge. It is evident that previous discharges in the area are transported out of the site by current and wave action.

34. It is likely that the gelatinous texture of the upper navigation channel sediments could promote smothering of benthos at the disposal sites to a greater extent than would otherwise be expected given the similarity between the sediments at the sites. The magnitude of such an impact cannot be determined without test dumps and extensive benthic sampling and, possibly, a bioassay. Sediments near the mouth of the navigation channel are more similar to those at the Tansy Point disposal site than were those further up the channel and would not be expected to have as severe a physical effect on discharge. Impacts would include smothering of some benthic organisms and temporarily elevated turbidity levels. An oily sheen appeared on the surface of the water during sediment sampling at RM's 1.5 and 2.0. This may also occur upon discharge of these sediments at the disposal sites. Such an esthetic impact is prohibited by the Oregon State Department of Environmental Quality (DEQ)[8] and does not meet EPA criteria.[5]

35. Water Quality Data. DO, conductivity, ORP, temperature and pH were measured in the Skipanon navigation channel, Area D, Tansy Point disposal site and the ocean using a Hydrolab 8000 Water Quality Monitoring System (tables 4 and 5). The DO's (8.65 to 11.57) and temperatures (9.7 to 18.4° C.) measured at all sites were suitable for the survival of adult salmonids. The ORP data (183 to 287) indicated the absence of strongly reducing or oxidizing chemical species. At the pH values found, the moderately high ORP levels indicated that the water in the system will readily oxidize and precipitate iron and manganese if the parameters are released upon dredged material disposal operations.[14] The pH (7.86 to 8.39) at all stations fell within the range which was suitable for the survival of both freshwater and marine aquatic life.[5] Turbidity measurements were made with a YSI turbidometer. The data (.12 to 10 NTU) indicated very clear water with minimal suspended solids levels. Since conductivity measurements were not taken during both low and high tides at all stations, the extent of fresh and salt water influence at each site could not be determined; however, the available data indicate that the navigation channel water was fresh during low tide, while Tansy Point was fresh in the

surface water and had a high salt content near the bottom. The depth of the halocline at the latter site during low tide on 21 August 1980 was located at approximately 6 meters. Area D was fresh to brackish in the surface water during high tide and had a high salt content near the bottom. The depth of the halocline at Area D during high tide on 20 August 1980 was located at 4 to 7 meters.

36. Sediment Chemical Data. A sediment toxicity bioassay on Skipanon River sediments from adjacent to the channel's fishing marina RM 1.7 was performed by the EPA from May 1976 until April 1977. The bioassay consisted of five replicates on five estuarine organisms. Yaquina Bay sediments (sand) were used in control bioassays. The bioassays determined that "there were no significant differences from the controls in the mean survival of any species exposed to sediment from the Skipanon River..."[15] This bioassay indicates that insignificant biological-chemical impacts should result from open water, estuarine discharge of dredged sediments from the Skipanon navigation channel.

37. The 12 sediment samples collected for elutriate testing in 1980 underwent analyses for up to 52 parameters (table 1). In addition, subsamples from 3 of these sediment samples underwent bulk sediment chemical analyses for 40 parameters (table 6). The elutriate data on the sediments from the proposed dredging area were compared to Corps guidelines and to disposal site receiving and elutriate water data to determine which parameters could be released at levels which might impact water or sediment quality at the receiving sites. Three parameters, organic carbon, mercury, and ammonia were present in the navigation channel sediment's eluate at levels above freshwater guidelines, and only manganese was released at levels exceeding the saltwater guidelines. These parameters are discussed below.

38. Organic carbon was present at levels slightly above the guidelines for freshwater in some of the navigation channel elutriate tests, but was always considerably below guidelines for saltwater. Both the elutriate and bulk chemical sediment data were considerably higher for the navigation channel than the Tansy Point disposal site. The bulk sediment data for the former site slightly exceeded guidelines. Organic carbon can be an indicator of a large variety of organic contaminants. The high carbon levels found in the

navigation channel were probably due to the large amounts of wood fiber which drifted into the channel from the lumber industries and log rafts adjoining it. Oil and grease from boat traffic and rainwater runoff may also have slightly contributed. Thirty-two manmade organic contaminants were measured but none were found in significant amounts in either the elutriate or bulk sediment analyses.

39. Levels of organics released into the water column upon dredged material discharge are expected to be minimal and impacts insignificant; however, the long-term impacts of disposal of the dredged sediments at the relatively non-contaminated disposal sites could be significant. Disposal of wood fiber on sediments which are normally characterized by low organic content can cause a decrease of interstitial dissolved oxygen, owing to chemical and biological degradation of the material. It can also impact existing benthic organisms by providing a substantially different type of substrate than that to which they are adapted. Both the benthos at the disposal sites and that in surrounding areas to which sediments may migrate can be impacted. The extent of the impact can be estimated with solid-phase bioassays such as are mentioned above. These tests indicated that the impact would be insignificant.

40. Ammonia is a common, highly soluble biproduct of the biological degradation of nitrogenous organic matter. The parameter is biodegraded by aerobic bacteria. In water, ammonia exists in unionized and ionized forms which are in equilibrium. A lower pH or higher temperature causes an increase in the highly toxic, unionized form. The unionized form decreases with increasing salinity. That portion of the ammonia which is in the unionized form in freshwater can be roughly estimated,[5] based on the temperature and pH of the water. The actual levels of unionized ammonia found during a disposal operation would be lower than those reported in table 1 since the salinity in the estuary is higher. The guideline level of .02 mg/l unionized ammonia was established for chronic exposure, not for temporary increases due to dredging operations.

41. Ammonia can be released in potentially significant amounts if sediments are discharged under conditions of little or no turn-over of water. The disposal sites, however, are characterized by fairly high energy regimes.

Disposal operations would cause only short-term, elevated ammonia levels at the inwater disposal sites. Water column impacts from ammonia during open water disposal operations should be minimal. On the other hand, releases from an upland disposal area could cause a chronic exposure problem; particularly if the dissolved oxygen or pH levels of the overflow are low and receiving waters are quiescent.

42. Mercury was detected at levels of .1 to .3 ug/l in the navigation channel sediment eluate. This level appears a good deal above the guideline level for freshwater, .0017 ug/l. However, a comparison of the two is not justified because the analytical detection limit for mercury is .1 ug/l. The guideline level was established by the EPA without regard for the technical feasibility of measuring the parameter. Comparison of the levels in the navigation channel eluate to those in the disposal site sediment eluates reveals relatively little difference. Also, the bulk sediment chemistry data for mercury was all below the guidelines. Given these various factors, mercury is not considered a contaminant of concern in the navigation channel sediments.

43. Manganese was released in excessive levels from the saltwater eluates of the navigation channel sediments. These levels (710 ug/l and 7,200 ug/l) were many times the Corps saltwater guideline (100 ug/l). This level was established to prevent chronic exposure problems in marine mollusks. Freshwater guidelines do not exist. The bulk sediment analyses indicated that the metal was not present in excessive levels in the proposed dredged material. Manganese is well-known to be readily released at high levels during elutriate tests. This attribute is the result of reduction of the insoluble, oxidized manganese to a soluble manganese (II) with decreasing pH, ORP, and oxygen such as can occur during elutriate tests. Such excessive releases are not expected to occur during ocean discharges of sediments since the amounts of dilution water prevent the dissolved oxygen, pH, and ORP from dropping to the same extent. Manganese which is elutriated is expected to rapidly reprecipitate thus causing only insignificant, short-term water quality impacts. No long-term impacts from release of manganese are expected at the ocean disposal sites or Tansy Point.

44. The bulk sediment data revealed that seven parameters, arsenic, cadmium, organic carbon, copper, nitrogen, phosphorus, and zinc were present in the sediments at levels above those found in the disposal site sediments and exceeding the guideline limits (table 6). Of these parameters, only organic carbon and nitrogen (ammonia) were also exceeded in the eluate samples and, as was discussed above, they should not significantly impact receiving water quality. Since the other parameters found at comparatively high levels in the bulk sediment analyses were not released in excessive levels during elutriate testing, they should not impact water quality during dredged material discharge activities. Given the EPA bioassay results, it is unlikely that they will be readily released from discharged sediments over the long term at levels which could be toxic to benthos or other aquatic life. To provide a more detailed assessment of their long-term impact at the discharge site, these parameters are discussed below.

45. Arsenic was present within the proposed dredged material (9 ug/g) at levels only slightly exceeding guidelines (8 ug/g). Since the dredged material level was three times the level in the disposal site sediments (3 ug/g) and greater than the concentrations which have been reported in the earth's crust (5 ug/g),[16] the level found in the dredged sediments is attributed to anthropogenic contamination.

46. Arsenic can be both directly toxic and can be accumulated by aquatic organisms though it evidently is not progressively concentrated.[5] In one study, the trivalent, inorganic arsenic was determined to be 10 to 15 times more toxic than the pentavalent form. The former was converted to the latter within 30 days and long-term survival of benthic organisms was estimated to be normal in sediments containing as much as 1,920 ug/g arsenic.[5] Since the level found in the navigation channel sediments was only 9 ug/g, significant impacts to benthos from arsenic are not expected. The toxicity or bioaccumulative capacity should not be significant.

47. Cadmium was present in the proposed dredged material at a level (7 ug/g) only slightly above the guidelines (6 ug/g), but three times that in the disposal sites (2 ug/g). The average content of cadmium in the earth's crust ranges from .15 to .2 ug/g.[19] This parameter has a high toxicity and

bioaccumulative capacity. Relative impacts from it may depend on a number of related factors including hardness and pH.

48. Since the dredged material levels were only slightly above guidelines and the EPA bioassay indicated no significant impacts, the cadmium content of the navigation channel sediments is not expected to significantly impact the disposal sites.

49. Copper was found in the navigation channel sediments at a level (50 ug/g) considerably above the disposal site sediments (4-5 ug/g) but only at the upper limit of the Corps guidelines (25-50 ug/g). Copper is not of particular concern in terms of toxicity to humans or bioaccumulative capacity to aquatic organisms. Its toxicity is related to pH, alkalinity, and hardness and varies widely among various species.[5]

50. Since the dredged sediments were only moderately polluted and the EPA bioassay indicated no significant impacts, copper is not expected to significantly impact the disposal site sediments.

51. Phosphate phosphorus was present in the navigation channel sediments in amounts which exceeded guidelines. Levels at the disposal sites were slightly below guideline levels. The parameter was also released in the navigation channel sediment's eluate at a concentration which slightly exceeded freshwater guidelines.

52. The parameter is primarily of concern because it can act as a fertilizer which may cause excessive, obnoxious blooms of algae in freshwater. Such impacts are of greatest concern during operations that cause long-term continuous release of the parameter--such as sewage outfalls. When releases are short-term, algal blooms which utilize phosphate are not established and the parameter reacts, rapidly forming insoluble precipitates which upon settling are not readily released in oxygenated waters.[17] Thus, inwater disposal operations would cause insignificant, short-term impacts to the water quality at the disposal sites. No significant impacts to benthos at the disposal sites are expected from the phosphorous.

53. Zinc was present in the navigation channel sediments at a level (300 ug/g) above both guidelines (90-200 ug/g) and disposal site sediment levels (22-40 ug/g). The toxicity of the metal to aquatic animals is modified by several environmental factors including hardness, temperature, and dissolved oxygen. It is not of particular concern in terms of toxicity to humans or bioaccumulative capacity.[5]

54. The level of zinc found indicates its source to be anthropogenic. It is expected to have minimal impact upon discharge.

CONCLUSIONS

55. The sediments in the Skipanon navigation channel did not meet the Portland District guidelines which exclude them from requiring a chemical-biological evaluation pursuant to 40 CFR 230.[1] They were composed of more than 20 percent silt and 6 percent volatile solids.

56. Additionally, the sediments did not meet the exemption criteria of Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (PL 92-532). Pursuant to this, the sediments require bioassay/bioaccumulation testing prior to open water disposal in the ocean. Use of the sediments for beach nourishment would generally not be acceptable since most beach nourishment sites are composed of sand and discharge of the navigation channel sediments on them would be unesthetic.

57. The bulk chemical testing on the navigation channel sediments revealed slightly elevated levels of arsenic, cadmium, organics, copper, nitrogen, phosphorous, and zinc. None of the levels found were very high. Organic carbon, mercury, and ammonia were released at excessive levels during freshwater elutriate testing and manganese was released in the saltwater elutriate tests. None of these parameters would be expected to cause significant water quality degradation upon open water disposal operations. Upland disposal site overflows could cause some water quality problems in the receiving water; particularly if the overflow contains low DO and pH levels.

58. Slight physiochemical impacts to benthos communities at the inwater disposal sites may occur from the organic content of the dredged materials discharged there. These impacts are not expected to be serious since the organics in the dredged sediments consist primarily of naturally occurring, biodegradable materials. Bioassays performed on the Skipanon River sediments confirm that benthos should not be significantly impacted.[15] Such organic materials are not generally of concern in terms of bioaccumulative potentials or toxic effects. The high energy regime of the inwater disposal sites will prevent the organics from impacting DO levels in the water though interstitial impacts could occur. If dredged material is disposed upland, the organics may cause low DO and pH levels in the overflow. Monitoring and management of the disposal facility to prevent the discharge from impacting receiving water must be performed.

59. Of probable greater importance to the inwater disposal sites ecosystem is the physical impact to benthos which can occur by discharging sediments. There is an immediate, lethal effect on benthos in an area which is receiving sediments, although various organisms have shown considerable ability to vertically migrate through and survive discharges.[18] This ability is often improved if the sediments discharged are similar to those at the receiving site. The extent of impacts to benthos cannot be determined without an extensive, costly benthic sampling program and test dumps. Given the extent of the impacts expected, such sampling is not considered economically justified.

60. Both upland and inwater disposal operations may cause negative esthetic impacts by increasing turbidity levels and forming oil slicks in the receiving water. At an upland disposal site, turbidity can be prevented by using a flocculant or appropriate management techniques and disposal facility designs to decrease the suspended solids levels. Oil slicks can be prevented by installing an oil boom around the facility's discharge weir. Impacts from turbidity or oil slicks at the inwater disposal sites are expected to be minimal and short-term.

61. No significant impacts to municipal water supplies, flow patterns, wildlife sanctuaries or refuges, wetlands, mudflats, vegetated shallows or human use characteristics are expected from discharging sediments at the inwater

disposal sites. Proposed upland disposal sites must be evaluated for such impacts on a case-by-case basis.

RECOMMENDATIONS

62. A recommendation for a Finding of Compliance with the "Guidelines for Specification of Disposal Sites for Dredged or Fill Material," as discussed in 40 CFR 230[1,20] is made for discharging sediments dredged from the Skipanon navigation channel, RM 0 to 2.8, at the following inwater disposal sites:

a. Tansy Point - Located just off the south shore of the Columbia River estuary opposite RM 10.

b. Area D - Latitude 46° 14' 27" N; longitude 123° 57' 00" W; 4,000 by 1,000 feet.

63. Dredged sediment may be discharged at authorized upland sites provided the disposal facility is managed and monitored to assure that the overflow will meet the following water quality requirements:

a. Dissolved oxygen must be a minimum of 5 mg/l and pH must range from 6.5 to 9.0 within an appropriate mixing zone (estimated at 100 feet downstream of the overflow).

b. Turbidity levels in the overflow should not exceed the upstream ambient by more than 50 JTU.

c. Upstream, downstream, and overflow water samples must be analyzed for metals, DO, pH, ammonia, and turbidity. Metals should equal background or District guideline levels within an appropriate mixing zone (estimated at 100 feet downstream of the overflow).

64. Navigation channel sediments cannot be discharged at designated, interim ocean disposal sites without bioassays and/or solid phase bioaccumulation studies being performed to supplement available bioassay data. Because of the

excessive organic content of the sediments, they should not be used for beach nourishment unless the nourishment site is characterized by high organic and silt content.

65. All disposal sites, and particularly proposed upland areas, must be coordinated with the Washington State Historic Preservation Officer, U.S. Environmental Protection Agency, U. S. Fish and Wildlife Service, Oregon Department of Environmental Quality, and any other private or public agency which has expressed interest in such operations.

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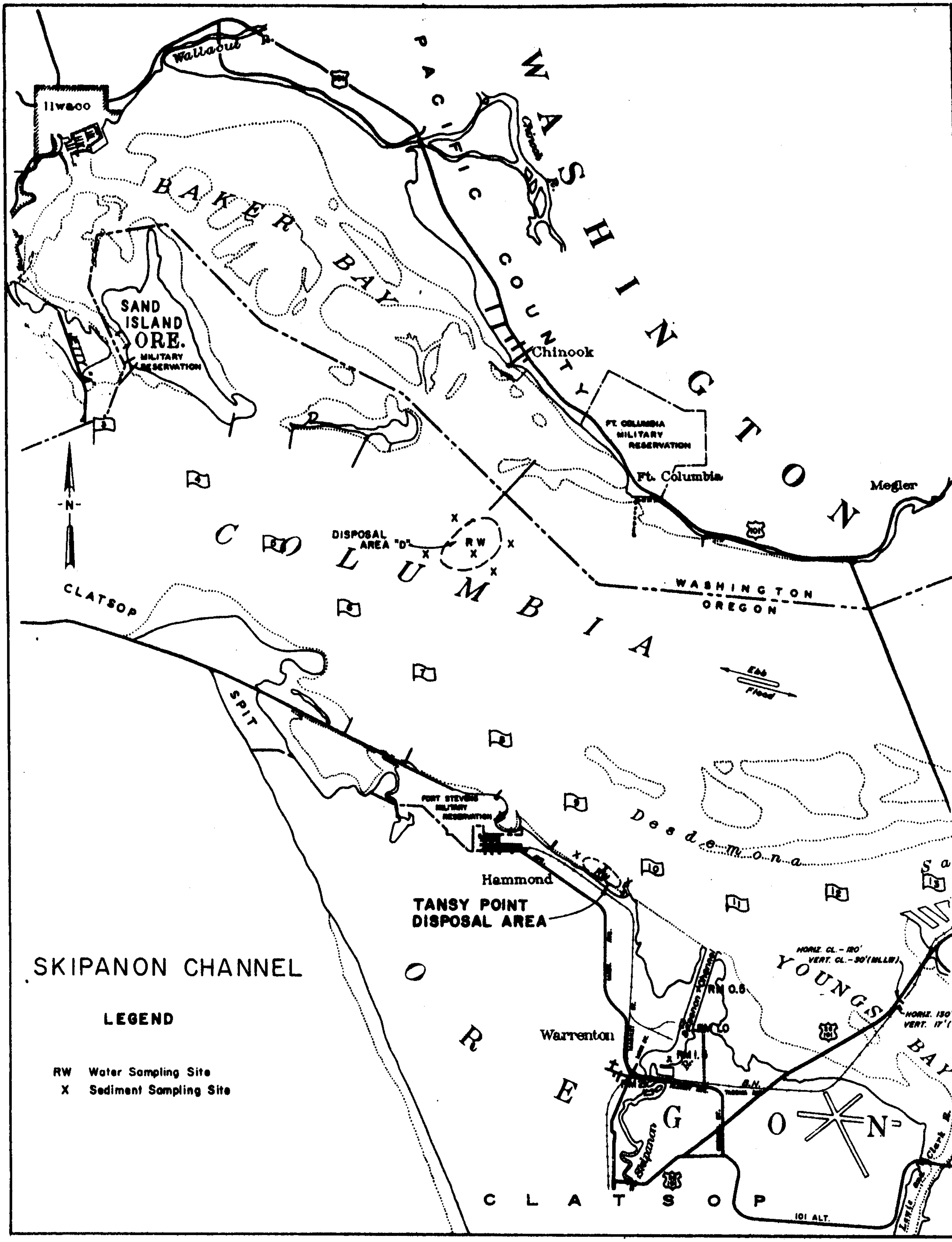
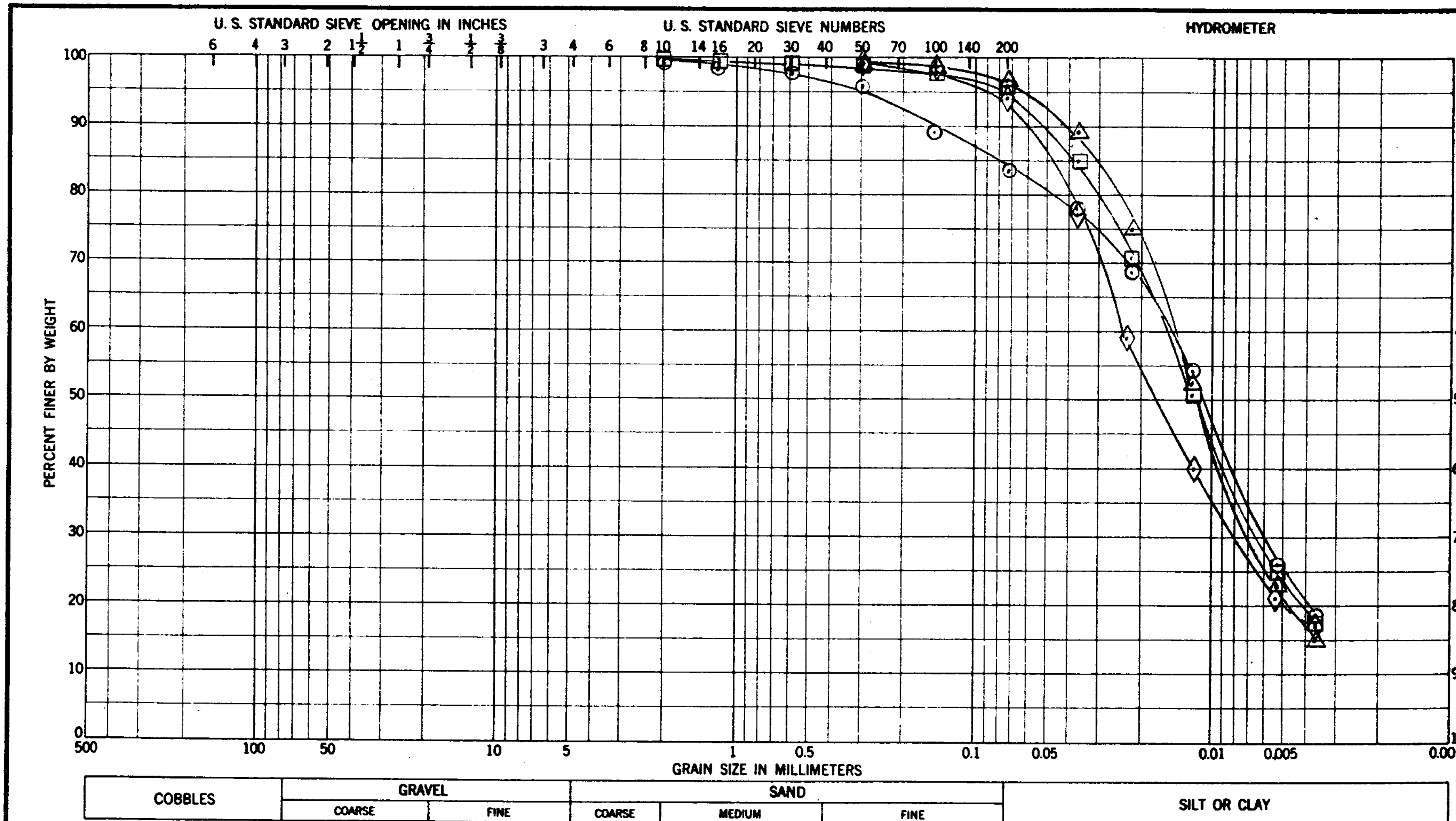


WASHINGTON
PACIFIC COUNTY
Ilwaco
Wallacut R.
Chinook
BAKER BAY
SAND ISLAND
ORE.
MILITARY RESERVATION
FT. COLUMBIA MILITARY RESERVATION
Ft. Columbia
Megler
DISPOSAL AREA "D"
RW
COLUMBIA
CLATSOP
SPIT
WASHINGTON
OREGON
Ebb
Flood
FORT STEVENS MILITARY RESERVATION
Desdemona Sa
Hammond
TANSY POINT DISPOSAL AREA
RM 0.6
RM 1.0
Warrenton
YOUNGS BAY
OREGON
CLATSOP
101 ALT.
Skipanon
SKIPANON CHANNEL
LEGEND
RW Water Sampling Site
X Sediment Sampling Site

FIGURE I



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
⊙ R.M.2.0	(0900)	Organic Sandy SILT (OL)				
△ R.M.1.5	(1000)	Organic SILT (OL)				
☐ R.M.1.0	(1130)	SILT (ML)				
◇ R.M.0.5	(1030)	SILT (ML)				

Project RIVER/COASTAL SEDIMENT ANALYSIS
Skipanon, Oregon

Area

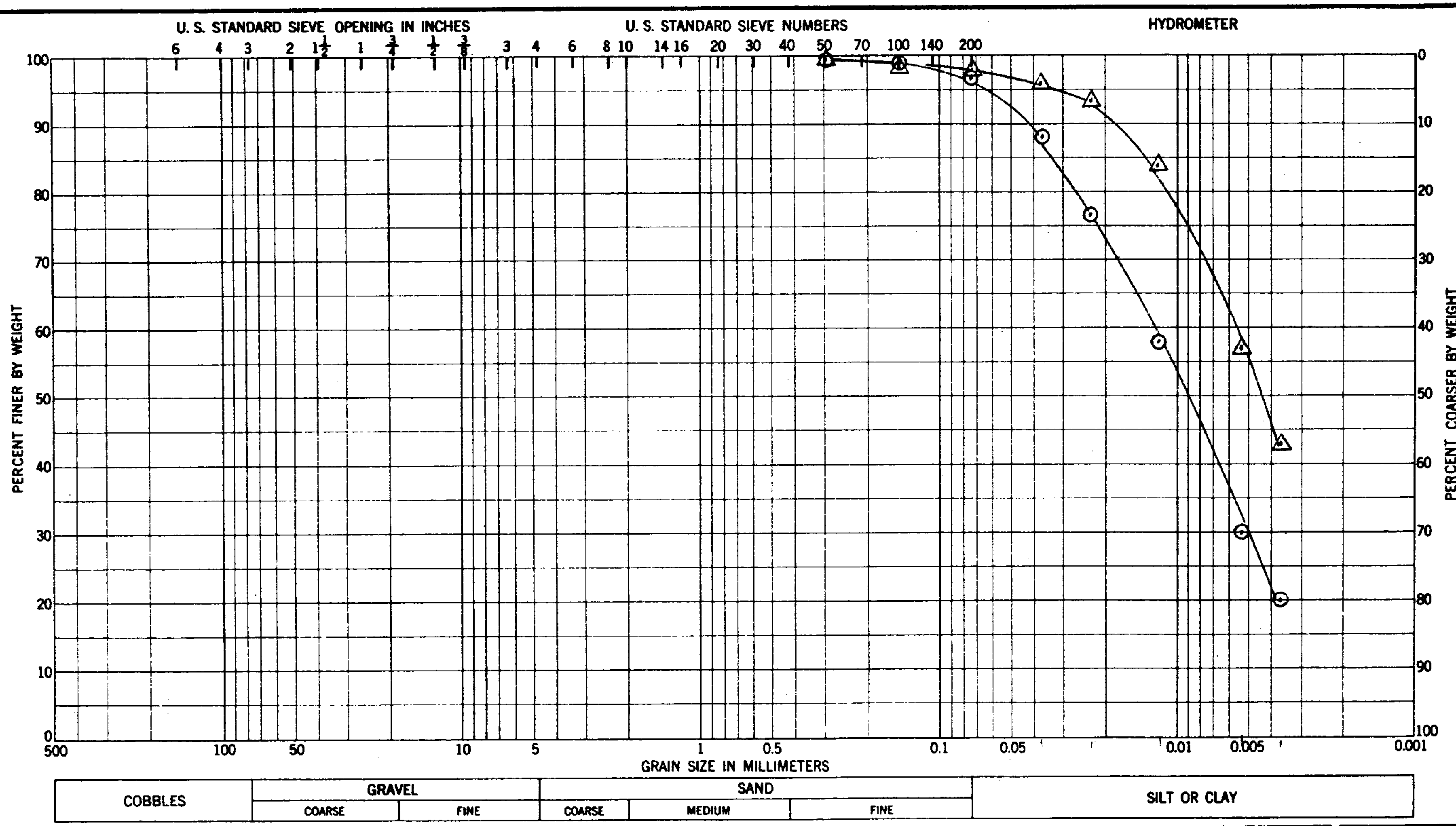
Boring No. Sampled: 22 July 1980

Date 22 OCT 1980 (80-Ch-650)

GRADATION CURVES NPD

ENG FORM 1 MAY 63 2087

FIGURE 2



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
⊙ Upstream	(1735)	SILT (ML)				
△ Middle 58 ft	(1730)	SILT (ML)				

Project RIVER/COASTAL SEDIMENT ANALYSIS
Tansy Point, Oregon

Area

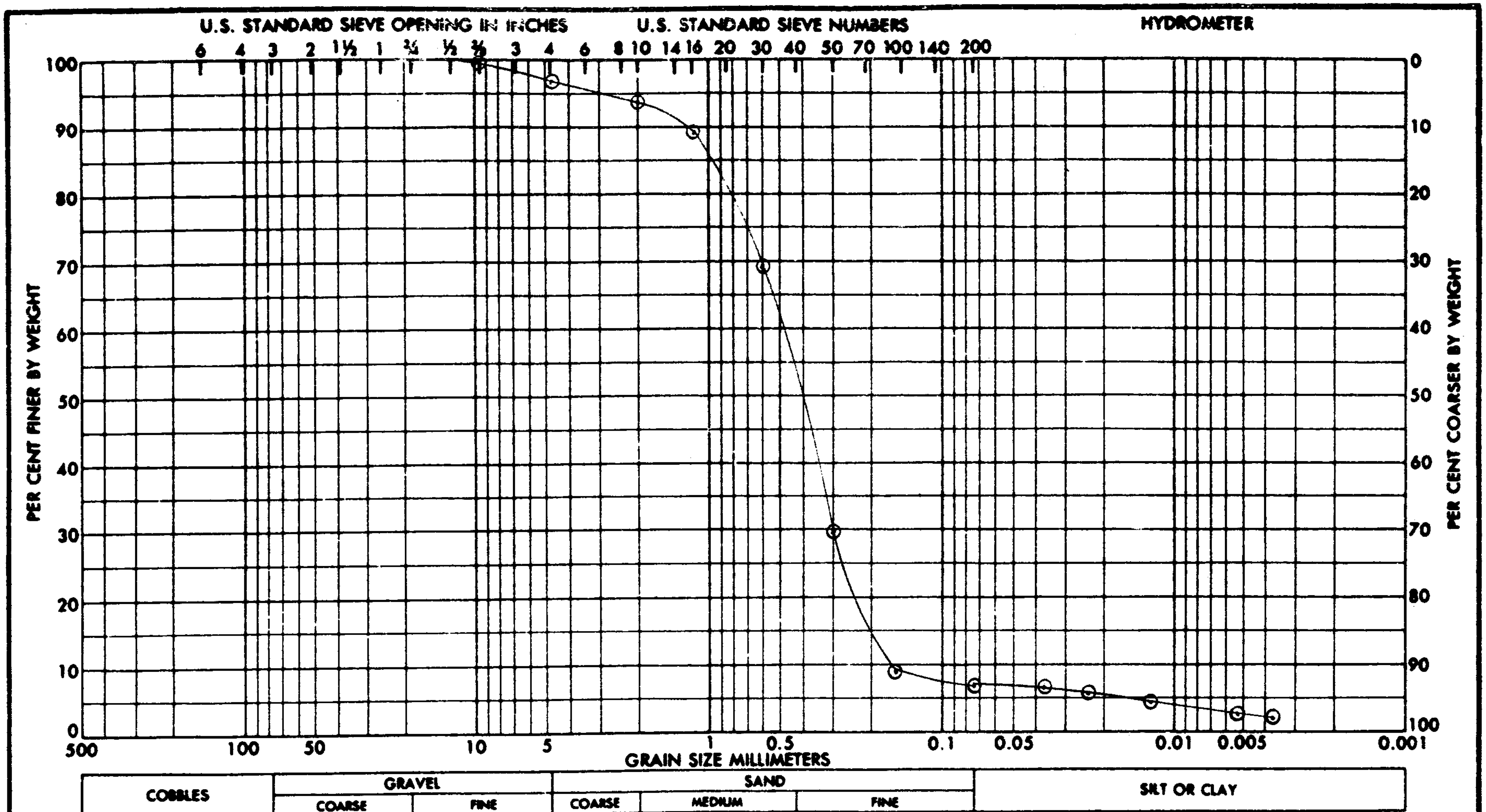
Boring No. Sampled: 22 July 1980

Date 22 OCT 1980 (80-Ch-650)

GRADATION CURVES NPD

ENG FORM 1 MAY 63 2087

FIGURE 3



	SAMPLE NO.	~~ELEV OR DEPTH~~	CLASSIFICATION	NAT W%	LL	PL	PI
⊙	19 Aug 80	(115)	Si. SAND (SP-SM)				

GRADATION CURVES NPD

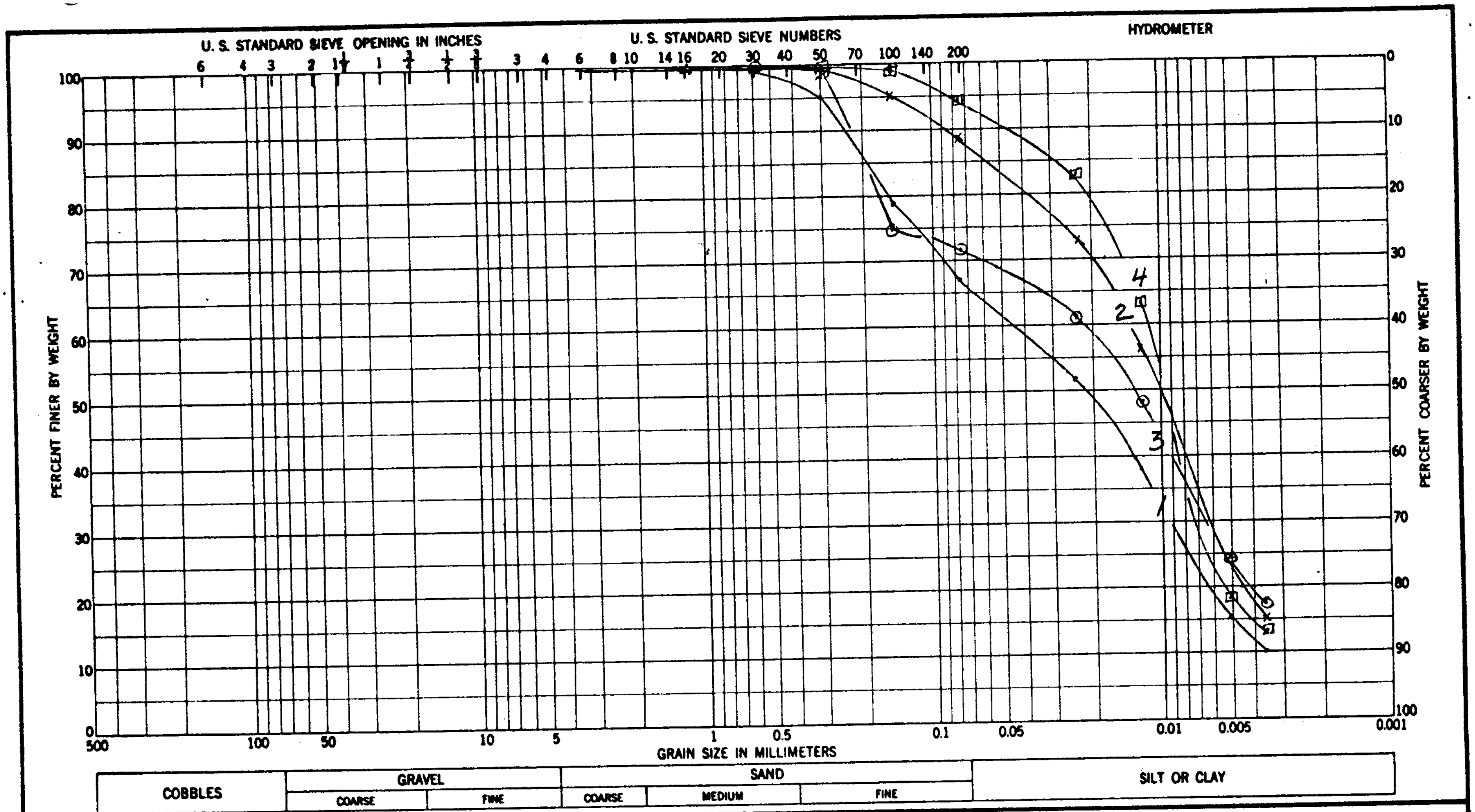
PROJECT RIVER/COASTAL SEDIMENT ANALYSIS

AREA Tansy Point - Downstream Site

BORING NO.

DATE 28 Jan 81 (81-S-816)

FIGURE 4



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
1		Sa. SILT (OL) Mile 01+50+00 RM 1.95				
2		Sa. SILT (OL) Mile 01+45+00 RM 1.85				
3		Sa. SILT (OL) Mile 01+39+00 RM 1.74				
4		SILT (OL) Mile 01+37+00 RM 1.70				

Project SKIPANON CHANNEL

Area Boat Basin Entrance

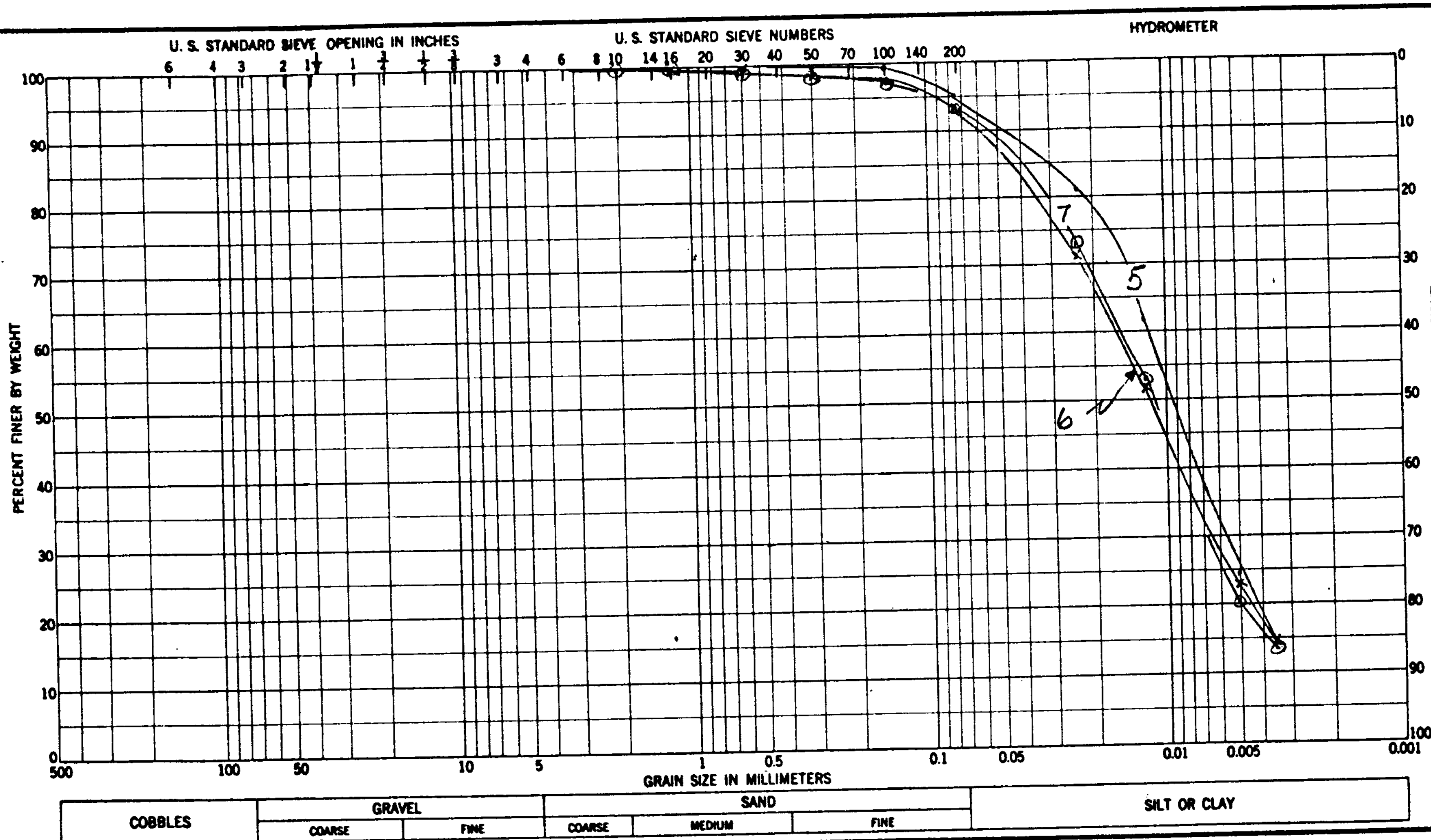
Boring No.

Date 31 Jan 1980 80-S-649

GRADATION CURVES NPD

ENG FORM 1 MAY 63 2087

FIGURE 5



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
5		SILT (OL) Mile 01+30+00 RM 1.57				
6		SILT (OL) Mile 01+20+00 RM 1.38				
7		SILT (ML) Mile 01+10+00 RM 1.19				

Project SKIPANON CHANNEL

Area Boat Basin Entrance

Boring No.

Date 31 Jan 80 80-S-649

GRADATION CURVES NPD

ENG FORM 1 MAY 63 2087

FIGURE 6

TABLE 1

Elutriate and Receiving Water Chemical Data

Skipanon River Navigation Channel and Dredged Material Disposal Sites

July - August 1980

PARAMETERS	SWE RM 0.5	FWE RM 0.5	FWE RM 1.0	FWE RM 1.5	SWE RM 2.0	FWE RM 2.0	OCEAN RCVG WATER	TANSY PT RCVG WATER	FWE TANSY PT UPSTREAM	FWE TANSY PT MIDDLE	FWE TANSY PT DOWNSTREAM	CORPS GUIDELINES
Arsenic, ug/l					2	3	1	1	1			440/508
Barium, ug/l					400	0	100	0	100			
Beryllium, ug/l					10	10	10	10	10			130/---
Cadmium, ug/l	0	0	0	0	0	0	0	0	1	1	1	1.5/59
Carbon, Organic, mg/l	18	35	17	26	8.9	22	2.7	2.7	6.5	2.5	4.9	
Chromium, ug/l	1	0	0	1	0	0	0	0	0	0	0	2200/
Copper, ug/l	3	0	1	0	1	19	49	2	1	0	2	52/30
Cyanide, ug/l					<5.0		<5.0	<5.0	1			
Iron, ug/l	630	20	30	190	170	70	200	30	60	80	60	1000/---
Lead, ug/l	0	0	0	0	0	0	4	1	1	0	1	74/668
Manganese, ug/l	77200	660	450	550	710	50	60	20	720	210	150	/100
Mercury, ug/l	.1	.6	.1	0	.1	.6	.1	.0	0	.1	.2	.0017/.37
Nickel, ug/l					0	0	2	0	6			1,100/ 140
Nitrogen, Ammonia mg/l	.26	19	12	24	8.6	4.8	.00	.00	.93	.15	.27	
Unionized Ammonia, mg/l	* .008	.65	.41	.82	2.9	.16	.00	.00	.03	.005	.009	.02
Nitrogen, Organic mg/l					.00	1.1	.32	1.6	.48			
Phenolics, ug/l	178	206	245	331			9	8	20	17	10	10200/5800**
Phosphorus, Total ug/l					62	152	58	58	62			100/---
Orthophosphate, ug/l	22	22	36	50	28	28	43	30	38	53	39	
Zinc, ug/l	40	10	10	10	30	10	50	20	30	20	30	180/170
Aldrin, ug/l					.00	.00	.00	.00	.00			3.0/1.3
Ametryne, ug/l						.0	.0	.0	.0			
Atratone, ug/l						.0	.0	.0	.0			
Atrazine, ug/l						.0	.0	.0	.0			
Chlordane, ug/l					.0	.0	.0	.0	.0			2.4/.09
Cyanazine, ug/l						.0	.0	.0	.0			
Cyprazine, ug/l						.0	.0	.0	.0			
DDD, ug/l					.00	.00	.00	.00	.00			
DDE, ug/l					.00	.00	.00	.00	.00			1,050/14.0
DDT, ug/l					.00	.00	.00	.00	.00			1.1/.13
Dieldrin, ug/l					.00	.00	.00	.00	.00			2.5/.71
Endosulfan, ug/l					.00	.00	.00	.00	.00			.22/.034
Endrin, ug/l					.00	.00	.00	.00	.00			.18/.037
Hept Epox, ug/l					.00	.00	.00	.00	.00			
Heptachlor, ug/l					.00	.00	.00	.00	.00			.50/.053
Lindane, ug/l					.00	.00	.00	.00	.00			2.0/.004
Methoxychlor, ug/l					.00	.00	.00	.00	.00			.03/.03
Mirex, ug/l					.00	.00	.00	.00	.00			.001/.001
PCB, ug/l					.0	.0	.0	.0	.0			2.0/10.0
PCN, ug/l					.0	.0	.0	.0	.0			
Perthane, ug/l					.00	.00	.00	.00	.00			
Prometone, ug/l						.0	.0	.0	.0			
Prometryne, ug/l						.0	.0	.0	.0			
Propazine, ug/l						.0	.0	.0	.Q			
Silvex, ug/l					.00	.00	.00		.00			
Simazine, ug/l						.0	.0	.0	.0			
Simetone, ug/l						.0	.0	.0	.0			
Simetryne, ug/l						.0	.0	.0	.0			
Toxaphene, ug/l					.0	.0	.0	.0	.0			1.6/.07
2, 4-D, ug/l					.00	.00	.00		.00			
2, 4-DP, ug/l					.00	.00	.00		.00			
2, 4, 5-T, ug/l					.00	.00	.00		.00			

RCVG - Receiving Water

ug/l = micrograms per liter

mg/l = milligrams per liter

FWE - Elutriate performed using fresh water from Tansy Point

SWE - Elutriate performed using saltwater from the ocean 1/2 mile seaward of the submerged end of Columbia River south jetty

* - Rough estimates extrapolated from tables in EPA's "Quality Criteria for Water."[5]

** - These criteria for phenolics was established for phenol. However, the phenolics analysis also measures larger compounds which contain phenol.

Table 1 (cont.)
Elutriate and Water Quality Data
Area D Dredged Material Disposal Site
Skipanon Navigation Channel, Oregon

PARAMETERS	FWE Area D NUS	FWE Area D SUS	FWE Area D NDS	FWE Area D SDS	FWE Area D Mid	RCVG Water Area D	FE/SE Guidelines
Arsenic, ug/l	1					1	440/508
Barium, ug/l	500					0	
Beryllium, ug/l	10					10	130/
Cadmium, ug/l	1	1	1	3	2	1	1.5/59
Carbon, Organic, mg/l	2.3	2.5	3.5	2.8	40	4	
Chromium, ug/l	0	0	0	0	0	1	21/1,260
Copper, ug/l	1	1	1	1	1	2	2200/
Cyanide, ug/l	1					2	52/30
Iron, ug/l	50	50	80	70	60	80	1,000/
Lead, ug/l	0	0	1	1	1	1	74/668
Manganese, ug/l	30	20	260	1500	170	20	/100
Mercury, ug/l	0	0	.1	.2	.1	.2	.0017/3.7
Nickel, ug/l	11					3	1,100/ 140
Nitrogen, Ammonia mg/l	.18	.09	1.5	2.8	2.1	.12	
Nitrogen, Organic mg/l	.32					.37	
Ammonia, Unionized mg/l*	.04	.18	.03	.06	.04	.002	.02
Phenolics, ug/l	6	7	7	14	42	5	10,200/5,800
Phosphorus, Total ug/l	78					87	100/
Orthophosphate, ug/l	62	53	72	34	35	60	
Zinc, ug/l	20	20	70	30	30	20	180/170
Aldrin, ug/l	.00					.00	3.0/1.3
Ametryne, ug/l	.0					.0	
Atratone, ug/l	.0					.0	
Atrazine, ug/l	.0					.0	
Chlordane, ug/l	.0					.0	2.4/.09
Cyanazine, ug/l	.0					.0	
Cyprazine, ug/l	.0					.0	
DDD, ug/l	.00					.00	
DDE, ug/l	.00					.00	1,050/14.0
DDT, ug/l	.00					.00	1.1/.13
Dieldrin, ug/l	.00					.00	2.5/.71
Endosulfan, ug/l	.00					.00	.22/.034
Endrin, ug/l	.00					.00	.18/.037
Hept Epox, ug/l	.00					.00	
Heptachlor, ug/l	.00					.00	.50/.053
Lindane, ug/l	.00					.00	2.0/.004
Methoxychlor, ug/l	.00					.00	.03/.03
Mirex, ug/l	.00					.00	.001/.001
PCB, ug/l	.0					.0	2.0/10.0
PCN, ug/l	.0					.0	
Perthane, ug/l	.00					.00	
Prometone, ug/l	.0					.0	
Prometryne, ug/l	.0					.0	
Propazine, ug/l	.0					.0	
Silvex, ug/l	.00					.00	
Simazine, ug/l	.0					.0	
Simetone, ug/l	.0					.0	
Simetryne, ug/l	.0					.0	
Toxaphene, ug/l	.0					.0	1.6/.07
2,4-D, ug/l	.00					.00	
2,4-DP, ug/l	.00					.00	
2,4,5-T, ug/l	.00					.00	

FWE - Elutriates ran with water from Area D.

TABLE 2
Sampling Locations and Methods
Skipanon Navigation Channel and Dredged Material Disposal Sites

Sampling location and depth	Sampling Method	Sampling Date	Sampling Time	Type of Sample			
				Benthos	Sediment (Physical)	Sediment (Channel)	Water
Ocean Water, 1/2 mile seaward of the end of North Jetty; 2 meters	Van Dorn 8 liter sampler	24 Jul 80	0901				B
Columbia River Receiving Water-Just offshore of Tongue Point; RM 18.5; 7 feet	Van Dorn	24 Jul 80	1500				B
Area D Receiving Water-Middle of Area D (46°-14' 27"-N, 123°-57'-00" W), RM 6.6;	Van Dorn	19 Aug 80	1300				B

TABLE 2 (cont.)
Sampling Locations and Methods
Skipanon Navigation Channel and Dredged Material Disposal Sites

Sampling location and depth	Sampling Method	Sampling Date	Sampling Time	Type of Sample			
				Benthos	Sediment (Physical)	Sediment (Channel)	Water
Tansy Point, Columbia RM 10+9; 200' upstream of DS; 50' (med. size sand with .25 inches of fines on top-possible ash)	Gravity Corer	19 Aug 80	0900			BF1 C	
	Ponar	22 Jul 80	1745	X	X		
Tansy Point, Columbia RM 9+50; in middle of DS, 58' (fine to medium sand with .25 inches of fine material on top) 2 meters	Ponar	22 Jul 80	1730	X	X		
	Gravity Corer	19 Aug 80				AF1	
		25 Jul 80	1500				B
Tansy Point, 200' downstream of DS; 50' (sand with clumps of clay. Some pumice grains and larger 'volcanic' rock)	Ponar	22 Jul 80	1715	X	X		
	Gravity Corer	19 Aug 80	1100			AF1	
Navigation Channel, RM .5, 12-15' (sandy muck with wood fibers)	Gravity Corer	22 Jul 80	1030		X	AS1	
	Gravity Corer	22 Jul 80	1030			AF1	
	Ponar			X			
Navigation Channel, RM 1.0, 15-20' (dark, sandy texture; somewhat oily)	Gravity Corer	22 Jul 80	1130		X	AF1	
	Ponar			X			
Navigation Channel, RM 2.0, 15' (sandy muck with wood)	Gravity Corer	22 Jul 80	0900		X	C BF1 BS1	
	Ponar			X			
Navigation Channel, RM 1.5, 12' (very oily, dark, jello-like texture)	Gravity Corer	22 Jul 80	1000		X	AF1	
	Ponar			X			
Area D-NUS (46°-14'-27" N, 123°-57'-00"W) Upstream of the north corner of disposal site opposite RM 7.0; 38 ft.	Corer	19 Aug 80	1400			BF2 C	
	Ponar	20 Aug 80	0855	X	X		

TABLE 2 (cont.)
Sampling Locations and Methods
Skipanon Navigation Cahnnel and Dredged Material Disposal Site

Sampling location and depth	Sampling Method	Sampling Date	Sampling Time	Type of Sample			
				Benthos	Sediment (Physical)	Sediment (Channel)	Water
Area D-SUS-Upstream of south corner of disposal site opposite RM 7.0; 38 feet	Corer	19 Aug 80	1500			AF2	
	Ponar	20 Aug 80	0915	X	X		
Area D-Mid-middle of Area D RM 6.6; 68'	Corer	19 Aug 80	1400			AF2	
	Ponar	20 Aug 80	0945	X	X		
Area D-NDS-Downstream of north corner of disposal site opposite RM 6.0; 55'	Corer	19 Aug 80	1400			AF2	
	Ponar	20 Aug 80	1000	X	X		
Area D-SDS-Downstream of corner of disposal site opposite RM 6.0; 55'	Corer	19 Aug 80	1400			AF2	
	Ponar	20 Aug 80	1020	X	X		

A - An "A" analysis includes analyses for approximately eleven metals and nutrients but no complex organic compounds.

B - A "B" analysis includes analyses for approximately 16 metals and nutrients and up to 32 complex organic contaminants.

C - Bulk sediment chemical analyses

F1 - Elutriate test performed using fresh water from Tansy Point.

F2 - Denotes an elutriate test which was performed using fresh water from Area D.

S1 - Elutriate test performed using salt water from 1/2 mile seaward of South Jetty.

DS - Dredged material disposal site.

RM - River mile.

TABLE 3

RIVER/COASTAL SEDIMENT ANALYSIS
Skipanon Navigation Channel and
Dredged Material Disposal Sites

Sample Identification	Specific Gravity of Water	Density of Matl in place gms/liter	Density of Median Solids gms/liter	Void Ratio	% Volatile Solids	% Wtr Content in place	Roundness Grade
Skipanon RM 2.0 (0900) 22 Jul 80	1.0073	1190	2444	6.85	13.79	282.3	Angular to Subangular
Skipanon RM 1.5 (1000) 22 Jul 80	1.0073	1276	2577	4.84	8.82	189.4	Angular to Subangular
Skipanon RM 1.0 (1130) 22 Jul 80	1.0073	1316	2592	4.13	7.30	160.4	Subangular to Subrounded
Skipanon RM 0.5 (1030) 22 Jul 80	*1.000	1.355	2617	3.56	7.15	135.9	Angular to Subangular
Tansy Point; Upstream (1735) 22 Jul 80	*1.000	1465	2617	2.48	2.89	94.8	Angular to Subangular
Tansy Point; Middle 58 ft (1730) 22 Jul 80	*1.000	1389	2617	3.16	3.23	120.7	Subangular to Subrounded
Tansy Point, Downstream side (1115) 19 Aug 80	1.0085	1979	2732	0.78	0.78		Subangular to Subrounded

* Distilled water used to saturate sample.

TABLE 3 (cont.)

RIVER/COASTAL SEDIMENT ANALYSIS
Skipanon Navigation Channel and
Dredged Material Disposal Sites

Sample Identification	Specific Gravity of Water	Density of Matl in place gms/liter	Density of Median Solids gms/liter	Void Ratio	% Volatile Solids	% Wtr Content in place	Roundness Grade
Skipanon RM 1.95 31 Jan 80	1.0028	1245	2493	5.155	13.44		Angular to Subangular
Skipanon RM 1.85 31 Jan 80	1.0053	1213	2491	6.136	13.43		Angular
Skipanon Boat Basin Entrance RM 1.74 31 Jan 80	1.0030	1297	2582	4.372	8.00		Angular to Subangular
Skipanon RM 1.70 31 Jan 80	1.0092	1237	2550	5.776	10.20		Angular
Skipanon RM 1.57 31 Jan 80	1.0060	1222	2579	6.296	9.01		Angular
Skipanon RM 1.38 31 Jan 80	1.0092	1340	2558	3.684	9.99		Angular
Skipanon RM 1.19 31 Jan 80	1.0068	1307	2539	4.107	3.87		Angular
Columbia River S.D.S. Area D @ 60' 20 Aug 80	1.011	1912	2744	0.92	1.57		Subangular to Subrounded
Columbia River Middle Area D @ 68' 20 August 1980	1.011	1938	2725	0.85	0.70		Subangular to Subrounded

* Distilled water used to saturate sample.

TABLE 3 (cont.)

RIVER/COASTAL SEDIMENT ANALYSIS
Skipanon Navigation Channel and
Dredged Material Disposal Sites

Sample Identification	Specific Gravity of Water	Density of Matl in place gms/liter	Density of Median Solids gms/liter	Void Ratio	% Volatile Solids	% Wtr Content in place	Roundness Grade
Columbia River N.D.S. Area D @ 68' 20 Aug 80	1.011	1920	2703	0.86	0.61		Subangular to Subrounded
Columbia River S.V.S. Area D @ 35' 20 Aug 80	1.009	1866	2715	0.99	0.91		Subangular to Subrounded
Columbia River N.U.S. Area D @ 38' 20 Aug 80	1.009	1934	2722	0.85	0.78		Subangular to Subrounded

* Distilled water used to saturate sample.

TABLE 4

WATER QUALITY DATA
Skipanon Navigation Channel, Tansy Point, and Ocean

DATE: 21 Aug 80 SAMPLING PERSONNEL: Pam Moore, Bob Ellard
WEATHER CONDITIONS:
COMMENTS: (Wildlife, vessel traffic, completion status of training jetty, sampling gear difficulties, sampling vessel, etc.): Low tide was at 1630 (+4/10 feet)

Parameter	Skipanon RM 2.0	Skipanon Mouth	Middle Tansy Point		Ocean*	
Depth, meters	1.1	.1	14.5	.2	9.6	.2
Dissolved Oxygen, mg/l	11.53	8.65	8.85	9.02	10.50	8.71
Conductivity, umho/cm x 10^{+5}	.107	.091	.495	.087	.530	.215
ORP	183	205	224	205	287	261
Temperature, 0° C.	18.1	18.4	10.8	18.1	9.7	15.7
pH	8.39	7.86	8.00	7.98	7.86	8.05
Turbidity, **, NTU	.12	.12			7	
Time	1530	1540	1557	1600	0921	0926
Maximum Depth, m	2.0	2.0	15.2		11.8	
Halocline, Depth/Conduct.			6.6/.349		2.1/.421	

* Located at end of North Columbia River Jetty
** Turbidity measurements made on water samples obtained on 22 July 1980

TABLE 5

HYDROLAB WATER QUALITY DATA
Area D Disposal Site
Mouth Columbia River

DATE: 8-20-80

SAMPLING PERSONNEL: Pam Moore, Bob Ellard, Pat Buckles, Phil Livingstone

WEATHER CONDITIONS: Overcast; 60°

COMMENTS: (Wildlife, vessel traffic, completion status of training jetty, sampling gear difficulties, sampling vessel, etc.) Fort Stevens sampling boat and hydrolab water quality testing system

	STATIONS							
Parameter	SDS	SDS	NDS	NDS	Mid Area D	Mid Area D	NUS	NUS
Depth, meters	1.0	13.2	2.4	9.8	2.0	14.8	9.3	1.8
Dissolved Oxygen, mg/l	8.74	11.25	8.99	11.60	9.08	10.38	11.57	9.69
Conductivity, umho/cm x 10^{-5}	.158	.505	.164	.492	.163	.507	.470	.122
Salinity, ppt	11		11		11			8
ORP	270	281	254	269	255	270	268	250
Temperature, °C	16.6	10.4	16.5	10.8	16.8	10.4	11.3	17.0
pH	7.90	7.99	7.99	8.02	7.93	8.02	8.00	7.98
Turbidity, NTU			10		8		10	
Time	1045	1054	1104	1108	1116			
Approximate Halocline, Depth/Cond, meters/umho/cm	4.6/.353			7.2/.477		6.5/.420	5.7/.420	
Maximum Depth, meters	16.9		12.0			19.9	11.8	

DS1 = Disposal Site Located immediately east of the Ilwaco Boat Basin.
DS2 = Disposal Site Located immediately west of the Ilwaco Boat Basin.

SDS = South and downstream of Area D.
NDS = North and downstream.
NUS = North and upstream.

TABLE 6
Bulk Sediment Chemical Analyses
Skipanon Navigation Channel and Proposed Dredged Material Disposal Sites

	8-19-80 Tansy Point Upstream of Disposal Site	7-22-80 Skipanon RM 2.0	8-19-80 Upstream Area D	Corps Guidelines
Aldrin, ug/kg	0.0	0.0	0.0	10,000
Arsenic, ug/g	3	9	3	3-8
Barium, ug/g	30	30	20	20-60
Beryllium, ug/g	0	0	0	10
Cadmium, ug/g	2	7	2	6
Carbon, Inorganic, g/kg	0.0	0.1	3.3	
Carbon, Organic, g/g	1.1	75	0.0	60
Carbon, Total, g/kg	1.1	75		60
Chlordane, ug/kg	0	3	0	10,000
Chromium, ug/g	6	12	4	25-75
Copper, ug/g	5	50	4	25-50
Cyanide, ug/g	0	0	1	.25
DDD, ug/kg	2.5	11	0.1	10,000
DDE, ug/kg	0.7	6.8	0.0	10,000
DDT, ug/kg	1.0	0.0	0.0	10,000
Dieldrin, ug/kg	0.0	0.0	0.0	10,000
Endosulfan, ug/kg	0.0	0.0	0.0	10,000
Endrin, ug/kg	0.0	0.0	0.0	10,000
Hept Epox, ug/kg	0.0	0.0	0.0	10,000
Heptachlor, ug/kg	0.0	0.0	0.0	10,000
Iron, ug/g	4500	19000	4700	17,000-25,000
Lead, ug/g	10	30	10	40-60
Lindane, ug/kg	0.0	0.0	0.0	
Manganese, ug/g	87	160	150	300-500
Mercury, ug/g	0.02	0.08	0.01	1
Mirex, ug/kg	0.0	0.0	0.0	10,000
Methoxychlor, ug/kg	0.0	0.0	0.0	10,000
Nickel, ug/g	10	20	10	20-50
Nitrogen, NH_4 mg/kg	6.0	86	2.0	
Nitrogen, NH_4+Org mg/kg	144	2280	73	1,000-2,000
PCB, ug/kg	0	28	0	10,000
PCN, ug/kg	0		0	10,000
Perthane, ug/kg	0.0	0.0	0.0	10,000
Phosphorus, Tot PO_4 mg/kg	630	730	430	420-650
Silvex, ug/kg	0	0	0	10,000
Toxaphene, ug/kg	0	0	0	10,000
Zinc, ug/g	40	300	22	90-200
2, 4-D, ug/kg	0	0	0	10,000
2, 4-DP, ug/kg	0	0	0	10,000
2, 4, 5-T, ug/kg	0	0	0	10,000

TABLE 7
SKIPANON HARBOR
POINT-SOURCE PERMITS OF
OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY

Permittee Name	Point Source Type	Location
Bioproducts Incorporated	Feed and Feed Ingredients	Warrenton
Pacific Shrimp Incorporated	Fish Processing	Warrenton
New England Fish Company	Fish Processing	Warrenton
Warrenton Deep Sea	Fish Processing	Warrenton
Warrenton, City of	Municipal Wastes	Warrenton

OTHER POTENTIAL POLLUTION SOURCES

Warrenton Lumber Company	Lumber Manufacturer/Sawmill	Warrenton
Log-rafting		Skipanon River
Pacific Machine Shop	Boat Repair	Warrenton
Warrenton Boatyard	Boat Repair	Warrenton
Agriculture	Crop, Dairy, and Beef Farming	Upstream of Warrenton